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COMPUTER-PRODUCED TIMBER MANAGEMENT PLANS: An Evaluation of Program TEVAP

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TEVAP (Timber EValuation And Planning), a computerized timber management planning system, was tested over a 2-year period on the Black Hills National Forest. The system's utility in the decisionmaking process was demonstrated for both broad and local areas.

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As do other modern managers, foresters increasingly find need for more detailed inventory information. This need has developed as uses of the forest and consequent management alternatives have increased. Information must be both extensive and detailed, and yet be accumulated and analyzed rapidly and accurately.

High-speed computers are helping to make such information-handling possible. Of particular interest to foresters is the use of computers in analyzing inventory data, and subsequent use of these data in preparation of management plans for forest areas. Presently, many forest inventories are conducted at a compartment examination level. The forest is divided into management units or compartments, and then subdivided into stands. Each stand is a basic management unit with homogeneous silvicultural characteristics. Data, including location, are collected from each stand. On a computer, these data can be assimilated and comprehensive inventory reports or forest maps produced in a matter of seconds. Whenever fire, insect infestation, silvicultural treatment, growth, or other phenomena affect the stand, records can be updated quickly and easily. The forest can then be managed as a continuous, dynamic system.

Various computerized programs have been written to retrieve and consolidate these types of data for management planning. Some of these programs include FINSYS (Wilson and Peters 1967, Frayer et. al. 1968), STX (Grosenbaugh 1967), INFORM,[2] RAM (Navon 1969), and TEVAP (Myers 1970). Some deal primarily with collection and analysis of inventory data, while others are designed for resource allocation and decisionmaking. However, all are useful aids in timber management planning.

Description of TEVAP

TEVAP (**T**imber **EV**aluation **A**nd **P**lanning), a computerized timber management planning system, rapidly processes forest inventory data into various tables and summaries, and prescribes management of even-aged and two-storied forest stands. Some of the summaries present the areas of the various forest types, while others present comprehensive breakdowns

[1] *At time of the study, the authors were, respectively, graduate student, Colorado State University; forester, timber management specialist, Black Hills National Forest; and associate professor of forest biometry, Department of Forest and Wood Sciences, Colorado State University. Study was conducted under contracts 16-215 and 16-254-CT with the Rocky Mountain Forest and Range Experiment Station, with central headquarters maintained in cooperation with Colorado State University, at Fort Collins.*

[2] *B-R Data Systems, Inc. 1968. Analysis of present operations and development information system concept for the Forest Service. Final report to U.S. Forest Service for Contract 13-327.*

of timber volumes by forest type and site index. These summaries give a detailed description of the timber resources. In addition to these summaries, and of more importance to the manager, TEVAP calculates work prescriptions and a management plan for the forest. The work prescriptions and plan present the allowable cut, volumes to be salvaged as the result of fires or insect attacks, and the cultural needs to be implemented in developing the forest toward a balanced distribution of age classes. Essentially, TEVAP produces all the information in a comprehensive timber management plan. An example, showing part of such a management plan, is presented in figure 1. The speed and low cost at which plans are generated should make traditional methods of preparing timber management plans obsolete.

THE WORKING CIRCLE CONSISTS OF 1604396.0 ACRES. OF THESE, 1226742.0 ACRES ARE UNDER OUR MANAGEMENT AND 377654.0 ACRES ARE INTERIOR TRACTS OF OTHER OWNERSHIP. OUR AREA INCLUDES 1083784.5 TIMBERED ACRES, 3757.5 PLANTABLE ACRES, 124396.0 ACRES MANAGED AS RANGE, AND 2957.0 ACRES OF HIGH RECREATION USE WHERE TIMBER YIELDS ARE INCIDENTAL AND NOT REGULATED.

THE TIMBER RESOURCE OF THIS WORKING CIRCLE WILL BE MANAGED AS FOLLOWS:

PONDEROSA - PONDEROSA PINE MANAGED WITH A TWO-CUT SHELTERWOOD SYSTEM.

SPRUCE - BLACK HILLS SPRUCE MANAGED WITH A TWO-CUT SHELTERWOOD SYSTEM.

REGULATION OF THE CUT WILL BE BY AREA WITH A VOLUME CHECK.

WITH BALANCED DISTRIBUTION OF AGE CLASSES, ALLOWABLE ANNUAL CUT WOULD BE AS FOLLOWS:

	ACRES	HUNDREDS OF CU. FT.	M. BD. FT.
REGENERATION CUTS			
PONDEROSA	9029.2	17856.2	88156.2
SPRUCE	28.4	8.6	80.8
FINAL REMOVAL CUTS			
PONDEROSA	9029.2	4404.3	68622.1
SPRUCE	28.4	46.6	215.6
INTERMEDIATE CUTS			
PONDEROSA	36116.9	46080.3	48067.4
SPRUCE	113.5	190.0	154.9
TOTAL FOR ONE YEAR			
PONDEROSA	45146.1	68340.8	204845.7
SPRUCE	141.9	245.2	451.3
TOTAL ALL GROUPS	45288.0	68586.0	205297.0

ONLY COMMERCIAL VOLUMES ARE INCLUDED IN THE TABLE ABOVE AND IN THE NEXT TABLE. CUTS ARE ASSIGNED TO BOARD-FOOT TOTALS IF POSSIBLE. THEY APPEAR IN CUBIC-FOOT TOTALS ONLY WHEN COMMERCIAL SAWLOG CUTS ARE NOT POSSIBLE. AREAS INCLUDE NONCOMMERCIAL.

FORMULA COMPUTATION OF ALLOWABLE ANNUAL CUT. CUBIC-FOOT VOLUMES INCLUDE SAWLOG TREES. HEYER FORMULA WITH M.A.I. FROM OPTIMUM YIELD TABLES AND COMPUTED GROWING STOCKS.

	ADJUSTMENT PERIOD	HUNDREDS OF CU. FT.	M BD. FT.
PONDEROSA	30.0	450086.0	184354.0
SPRUCE	30.0	3528.0	1221.7

Figure 1.--Guide for management--Black Hills National Forest. Total Forest summary, February 19, 1973.

The Test

The program was tested over a 2-year period using data from the Black Hills National Forest in South Dakota. The test was to determine (1) the value of TEVAP in actually managing the timber resource of the Black Hills, and (2) costs incurred in using the program. Data were supplied by Forest Service personnel on the Black Hills. A study team at Colorado State University ran the program and made necessary alterations.

At the time of the test, the Black Hills timber resource was being managed by two different silvicultural systems. Because of the land area and wood volume involved, the most widely used was a shelterwood system for ponderosa pine (Pinus ponderosa). In the second, white spruce (Picea glauca) was initially managed under a clearcut system that was later converted to a shelterwood system. Each of these silvicultural systems is called a working group, and both groups were easily handled by TEVAP, since the necessary species-specific equations were incorporated in the program (Myers 1970). It soon became obvious, however, that more working groups would be needed on the Black Hills. One newly proposed working group was ponderosa pine managed to perpetuate esthetic and recreational values. To accommodate this change, provisions were made in TEVAP to store up to 100 working groups, of which any five could be used in a single run of the program. Although a single area may not include more than five working groups, a single version of TEVAP may be used on a regional basis where forest types and silvicultural systems may vary.

One of the problems in implementing all options of TEVAP was that, at the onset of the test, detailed in-place data for the Black Hills National Forest were not available. However, enough information was available from old inventory records to produce some in-place data. Using one of the area calculation options in TEVAP, these limited data were expanded to produce output representative of the total forest. Comparisons of TEVAP results with previous inventory summaries showed the TEVAP results to be reasonably accurate. As compartments were delineated and more in-place data gathered, the more complete information was added to the system and the management plan updated.

As in many western forests, the Black Hills National Forest consists of large amounts of timber in the same age class — in this case, however, a predominantly young age class. It is difficult to convert a rather homogeneously aged forest to a forest with a balanced age distribution, a management goal to provide a continuous and reasonably uniform supply of timber, and to help control fire, insects, and disease. TEVAP was used to help solve these conversion problems. One part of the output from TEVAP is a yield table for each site index class of each working group. This yield table shows the stand characteristics and yield per acre for a theoretical, managed stand from regeneration to final harvest cut. Using this yield table, timber volumes for the theoretical forest with a balanced distribution of age classes, were calculated by TEVAP and compared to the actual volumes on the forest. The comparisons were printed in a table showing the age classes which are deficient or have surpluses in volume. TEVAP then calculated and printed a work plan to help develop the total forest toward a balanced distribution of age classes. The work plan showed the kinds of activities to be done in the current period and the volumes to be obtained. Finally, TEVAP generated a guide to management which included a summary of forest acreage and the allowable cut for the forest.

Aside from TEVAP's use in management planning, it also gives comprehensive inventory information, including breakdowns of timber volumes by site class or forest type, and various breakdowns of forest acreages.

Results

Applying the TEVAP program to timber management in the Black Hills resulted in substantial savings in cost and time.[3] The largest of these cost savings was due to the increased efficiency in producing management plans. Past manual development of management plans required much time. Costs in excess of $25,000 per working circle were commonplace. Now, management plans can be developed at approximately $10,000 for a working circle. Aside from the savings in cost, the time savings provides forest managers with more time for other duties.

With this fast and less expensive method, management plans can be produced more often. Previously, management plans for the Black Hills were produced every 10 years. If, during this 10-year period, a large fire, insect infestation, or change in lumber needs occurred, the forest manager could only make educated guesses as to the effect of this unforeseen

[3] *Frayer, W. E., Metcalf, G. E., and B. M. Edwards. 1972. Simulation of a regional data center for decision making in forest management. Final report to U.S. Forest Service for Contracts 16-215, 16-254-CT.*

event on the total forest. A new management plan can now be produced whenever necessary. During the test, for example, the management plan for the entire Black Hills National Forest was updated at least twice annually at a cost of $500 per revision. This includes the cost of data manipulation, updating inventory records, and computer charges.

Although direct cost savings are often easy to find when applying computerized techniques, hidden costs can occasionally offset them. An example of such hidden costs might be expensive data-gathering processes, or increased workload on personnel. Such hidden costs were not encountered on the Black Hills. Because TEVAP can produce inventory summaries and management plans with limited in-place data, long-range inventory plans did not have to be changed. As more in-place data were gathered, more accurate TEVAP output was obtained. Managers were not overburdened with additional work, and did not have to change their inventory methods substantially.

The Black Hills test additionally demonstrated TEVAP's flexibility. The program was originally written to provide inventory analysis and management plans on a working circle scale; however, Black Hills personnel found several other uses for the program. One of these was production of management plans for individual Ranger Districts or planning areas. A second use was for calculating timber volumes on timber sale areas. TEVAP was also used as a simulation program to determine the results possible with various management alternatives.

The use of TEVAP on the Black Hills National Forest has resulted in many immediate and long-range timber management planning benefits. Fast and accurate analysis of inventory data by TEVAP not only saves time and money, but also increases reliability of planning. Better management practices became evident on the ground. As resource managers use TEVAP, their planning job not only becomes easier, but is also more thorough and comprehensive. TEVAP and its system of inventory data storage and updating help the resource planner to better view the productive timber base of the forest as a continuous dynamic system.

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